DIVISION 2 - SITEWORK

SECTION 02220

EARTHWORK FOR UTILITIES

PART 1 - GENERAL

1.1 SCOPE

A. Description of Work

1. Provide all labor, material and equipment to excavate pipe trenches and backfill after the installation of the pipe, all in accordance with the Drawings and as specified herein.

B. Related Work Specified Elsewhere

1. Section 02020, EROSION AND SEDIMENT CONTROL PLAN
2. Section 02110, CLEARING AND GRUBBING
3. Section 02533, FORCE MAIN

1.2 LINES AND GRADES

A. Grades

1. Pipes shall be laid true to the lines and grades shown on the Drawings. The grade shown on the profile is the invert to which the work must conform. Work not conforming to the grade shall be corrected by the Contractor at his own expense.
2. The Contractor is responsible for maintaining the line and grade. The pipe shall be checked at each 50 foot interval to assure that it is on the correct line and grade.

B. Locations of Lines

1. The locations of the proposed lines are shown on the Drawings.
2. Approximate depths are shown on the Drawings.

3. The Engineer reserves the right to make changes in lines and grades of pipe lines and in locations of pipes and manholes when such changes may be necessary or advantageous.

C. Changes In Pipe Locations or Grade

1. The locations of the proposed piping and appurtenances are shown on the drawings.

2. Contours, if shown on the Contract Drawings, are for bidding and construction estimates only. Contours are not guaranteed.

3. Changes in line and grade of pipe lines and appurtenances may be ordered by the Engineer whenever such changes are advantageous or necessary for the betterment of the project. No claims for additional compensation resulting from changes in line or grade will be allowed, unless such changes are ordered after trenching has been done. In such cases, the value of the work to be abandoned shall be agreed upon between the Contractor and the Engineer at the time the change is ordered. If the Contractor fails to notify the Engineer so the cost of the work to be abandoned may be correctly determined, the Contractor shall not be allowed his claim by the Owner.

1.3 CLEARING

A. Clearing of the site is described in Section 02110, CLEARING AND GRUBBING.

PART 2 - PRODUCTS

2.1 BACKFILLING MATERIALS-GENERAL

A. In general, materials used for fill shall be foreign materials and be brought to the site from acceptable sources.

B. Present on-site materials excavated in the course of construction which are deemed suitable by the Engineer may be stored on the site for use as backfill.

C. All material, whether from the excavation or from borrow, shall be of such nature that after it has been placed and properly compacted, it will make dense, stable fill. It shall not contain vegetation, cinders, ashes, refuse, masses of roots, stones larger than size allowed in the following paragraph, or porous matter. Organic matter shall not exceed minor quantities and shall be well distributed.

2.2 SUITABLE MATERIALS

A. General Backfill and Fill Material

1. Suitable material shall be capable of being compacted as specified in paragraph 3.13B, "Backfilling in Non-traffic Areas" of this Section.

2. Utility Trench Backfill

   a. Excavated material from the trench or materials from other sources which are free from large clods, roots or stones larger than 1-inch.

B. Crushed Stone (Pipe Bedding - Granular Material)

1. Crushed stone shall be ASTM C33, gradation 68 not washed, with fines present to stabilize it in the trench. If amount of fines is insufficient, then stones screening shall be added to extent required to stabilize it in the trench.

2. Sharp stones and crushed rock (larger than 3/4-inch) shall be excluded from the bedding material.

C. Select Backfill

1. Select backfill shall be dense graded aggregate size number 21A of the Virginia Department of Transportation Road and Bridge Specifications, (latest edition).

D. Riprap

1. All stone for riprap shall consist of rough unhewn quarry stone weighing not less than 165 pounds per cubic foot, and as nearly rectangular in section as practicable. The stone shall be resistant to the action of air, temperature changes, and water; it shall be sound dense, and suitable in all other respects for the purpose intended. The stone shall be a well graded mixture with individual pieces raging in weight from 15 to 150 pounds. Over and undersize stones will be permitted to such extent that sizes larger than 150 pounds shall not exceed 10 percent and sizes smaller than 15 pounds shall not exceed 5 percent. Sizes larger than 200 pounds will not be permitted. (Approximately 70 percent of the stones shall weigh from 100 to 150 pounds).

a. A 6-inch thick filter blanket of select backfill shall be placed as a bed for riprap.

b. Riprap shall be placed in such a manner as to insure that the larger pieces are distributed uniformly and that the small pieces will fill the spaces between the larger pieces. After placing, the riprap shall present a reasonably smooth surface to the thickness shown on the Plans.

c. After riprap is in place, the voids shall be completely filled with crushed stone. The crushed stone shall be worked into the crevices between the rocks with rodding or other approved methods.

E. Concrete

1. Concrete used for cradles, thrust blocks, or encasement shall be as specified in Section 03300, CAST-IN-PLACE CONCRETE. Tests of concrete for this usage are waived.

PART 3 - EXECUTION

3.1 EXECUTION

A. General

1. Perform all excavation of every description and of whatever substances encountered to the depth shown on the Drawings.

2. All excavated materials not required for fill or backfill shall be removed from the site of work by the Contractor, but none shall be deposited on private property until written consent of the property owner has been filed with the Engineer.

3. All excavation shall be made by open cut unless otherwise authorized by the Engineer. Side walls of trenches shall be kept vertical and shall be properly sheeted and braced.

4. Trenches shall be excavated true to line so that the trench width is not more than the outside pipe diameter, plus 18-inches for up to 20-inch pipe, or outside diameter, plus 24-inches for over 20-inch pipe.

5. When applicable, holes of proper size shall be excavated at joints and pipe line appurtenances to ensure that the pipe will be resting for its entire length upon the bottom of the trench.

6. Where damage is liable to result from withdrawing sheeting, the sheeting shall be left in place. Sheeting shall be left in place only when agreed to or requested by the Engineer.

7. Care shall be taken not to excavate below the depth specified.

B. Rock

1. All excavation shall be unclassified regardless of depth or material encountered.

2. Boulders in Excavation: The Contractor shall be responsible for removal and off-site disposal of boulders unearthed during his excavation unless otherwise directed by the Owner.

C. Excavation Below Specified Grade

1. Where the bottom of the trench, by mistake of the Contractor, is taken out to a greater depth than specified for a given pipe bedding the trench shall be brought back to grade as follows:

   a. Where the pipe was to be supported by ordinary bedding the over-excavation shall be filled with crushed stone so as to comply with the bedding requirements of crushed stone foundation.

   b. When the pipe was to be supported by crushed stone cradle, crushed stone encasement, concrete encasement or concrete cradle the over-excavation shall be filled with crushed stone so as to comply with the requirements for crushed stone cradle.

2. Refilling with earth to bring the bottom of the trench to the proper grade will not be permitted.

3. This additional work and material required due to the over-excavation shall be furnished and installed by the Contractor at his expense.

D. Blasting

1. No blasting will be allowed.

3.2 EXCAVATION NEAR EXISTING STRUCTURES AND UTILITIES

A. Conduct all excavation near pipes, conduits or other underground structures with extreme care. If manual excavation is required to locate utilities and/or underground structures, or if excavation by hand is required in the installation of any piping or other

structures included in the project, no extra compensation is authorized. Protection of existing utilities and structures is the responsibility of the Contractor.

B. Excavation near structures will not be allowed closer to the structure than the depth of the excavation below the bottom of the foundation without shoring the excavation with sheathing.

C. The Contractor shall carefully protect all land monuments and property markers from disturbance and damage until an authorized agent has witnessed or otherwise referenced their locations. These monuments and/or markers shall then only be removed when authorized by the agent or Owner. Monuments and/or markers shall be reinstalled by the Contractor to the satisfaction of the property owner or agent.

3.3 PROTECTION OF EXISTING STRUCTURES

A. All existing pipes, poles, wires, fences, curbings, property-line markers, storm water management and other structures which must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from damage by the Contractor.

B. In case of damage to any structure, the Contractor shall notify the appropriate party so that proper steps may be taken to repair any and all damage done. If the owner of the structure wishes to make his own repairs, the Contractor shall reimburse the owner of the structure for all the time and materials required to make his repairs.

C. When the owners of the damaged structures do not wish to make the repairs themselves, all damages shall be repaired by the Contractor, or, if not promptly done by him, the Owner may have the repairs made at the expense of the Contractor.

D. All utility services shall be supported by suitable means so that the services shall not fail when tamping and settling occurs.

E. The Contractor shall not be compensated for any additional work involved if the utilities or underground structures cross the trench line transversely above or below the pipe.

3.4 CARE AND RESTORATION OF PROPERTY.

A. Excavating machinery and cranes shall be operated with care to prevent damage to existing structures, paving and/or wires.

B. It is suggested that to protect the pavement and shoulders, all equipment should have rubber wheels or runners and should have rubber, wood or similar protective pads between the outriggers and the surface unless otherwise authorized by the Owner or VDOT. In the event that other than rubber equipped machinery is authorized for use,

the pavement and shoulders should be protected by the use of matting, wood or other suitable protective material having a minimum thickness of four (4) inches. In any event it shall be the Contractor's responsibility to take whatever steps that are necessary to protect pavement and shoulders.

C. The Contractor must exercise care not to damage paving, curb, inlets, or sidewalks beyond the limits shown on the Plans. Any damages to areas outside the limits as shown on the Plans shall be replaced in kind by the Contractor at his own expense, to the satisfaction of the Owner unless the Drawings indicate they are to replaced.

D. The restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

3.5 TRENCHING

A. Trenches shall be dug to the depth required by the Contract Documents adding, however, to such depths the thickness of the pipe and required bedding. The width of the trench shall be as indicated or as specified. A recess sufficiently large enough to receive the couplings, where applicable, and to permit making the joints, shall be cut out of the bottom of the trench.

B. During installation, upon encountering quicksand or a wet spongy material, or soft and yielding soil conditions that are judged by the Engineer to be unsuitable for bedding pipe and/or appurtenance, the Engineer will order the Contractor in writing to excavate below the specified grade to a depth where, in the judgement of the Engineer, unsuitable soil conditions exist. The resultant over excavation shall be backfilled to the specified grade using materials approved by the Engineer for such use. Once the depth of the soft material has been determined, one of the following methods of construction work shall be used as determined by the Engineer:

1. Installation by the quicksand excavation method as specified in paragraph 3.7.

2. Crushed stone foundation as specified in paragraph 3.11.

3. Concrete cradle or encasement as specified in paragraph 3.10.

3.6 SHEETING AND SHORING

A. Where sheeting, shoring, bracing, or trench boxes are used, they must be designed by a Professional Engineer licensed to practice in the State of Virginia. Said Engineer shall provide the Contractor with a certification signed and sealed by him stating that the design of the sheeting and bracing conforms to all applicable requirements of the Virginia Construction Safety Code and the Occupational Health and Safety Act. Copies of this certification shall be submitted to the Engineer.

B. Trench shall, at all times be properly protected to prevent accidents, caving of the sides of the trench or breaking of the ground outside of the lines of the trenches proper or damage to buildings or other structures along the line of construction. Underground structures of all types shall be protected by the Contractor who shall use all necessary shoring, bracing or other appliances for the protection of same. Care must be taken not to damage water mains, water service pipes, drain pipes, sanitary or stormwater sewers, gas mains, oil mains, electrical conduits or other structures encountered on the lines of the Work.

C. The Contractor must follow the proposed sheeting plans submitted. No deviations may be made from the filed procedure without first submitting a revised sheeting and bracing plan, signed and certified as required for the original submission, by the same licensed Professional Engineer who prepared the original submission.

D. No shoring shall be left in place unless so authorized by the Engineer.

E. All sheeting and bracing not to be left in place shall be carefully removed in such a manner as not to endanger the construction or other structures. All voids left or caused by withdrawal of sheering shall be immediately backfilled with well-compacted material.

F. When installing pipe the sheeting and shoring shall not project below a point one foot above the top of pipe, except during quicksand excavation or to stabilize trench bottom.

G. If when installing pipe, sheeting must be placed below the pipe invert to stabilize trench bottoms, the sheeting shall be left in place from the trench bottom to a point 1 foot 6 inches above the top of the pipe, and the remainder of the sheeting cut and removed before final backfilling.

3.7 QUICKSAND EXCAVATION

A. Where quicksand excavation is encountered, the Contractor shall drive either tight tongue and groove wooden sheet piling or steel sheet piling to a depth which will effectively cut off the flow of sand. Well points and other methods shall be used to dewater the trench. Excavation and construction shall following as rapidly as possible thereafter. A satisfactory foundation must, however, be secured either by close tongue and groove planking held by piling or some other acceptable method. Where pipe is to be constructed through quicksand excavation, the trench shall be carried to a sufficient depth below the grade line to permit the pipe to be encased in concrete, on a 2-inch x 10-inch plank platform or cradle.

B. The Contractor shall comply with Paragraph 3.6A of this Section of the Specifications for design of the sheet piling.

3.8 TRENCHING IN ADVANCE OF PIPE LAYING

A. The trench for the pipe lines shall not be opened for a distance of more than 500 feet at any one time. At no time will the Contractor be permitted to leave the trench open at the end of a working day.

B. If concrete is to be installed for pipe cradle or encasement, longer lengths of trench may be left open with the Owner's approval, provided that all trenches are properly secured and protected.

3.9 KEEPING TRENCH DRY

A. All ground water which may be found in the trenches and any water which may get into them from any cause whatsoever shall be pumped or bailed out so that the trench shall be dry during pipe laying period. No water shall be permitted to reach concrete until it has set sufficiently. All water pumped from the trenches shall be disposed of in accordance with Section 02020, EROSION AND SEDIMENT CONTROL. The Contractor shall provide a minimum to two pumps for each trench opened in wet ground, one operating and one standby. The standby pump shall be of a size that will replace the largest operating pump.

B. The Contractor shall provide and place all necessary flumes or other channels of adequate size to temporarily carry all streams, brooks, stormwater or other water which may flow along or across the lines of the pipe line. All flumes or channels thus utilized shall be tight so as to prevent leakage into the trenches. Water pumped from trenches shall be led to a natural watercourse in accordance with Section 02020, EROSION AND SEDIMENT CONTROL.

3.10 PIPE BEDDING

A. General

1. Avoid contact between the pipe and compaction equipment. The tampers shall be hand or pneumatic of the proper size to operate between trench wall and pipe.

2. Compaction equipment shall not be used directly over the pipe while placing the pipe bedding.

3. Pipe bedding shall, in all cases, extend up until 18 inches of cover has been built up over the pipe unless otherwise noted on the plans.

4. Refer to the LCSA Standards Manual for bedding requirements.

5. The bedding shall be compacted to not less than 95% of the maximum dry density as determined by ASTM D1557.

B. Crushed Stone Cradle (Granular Material)

1. Pipe shall be supported in a crushed stone cradle. The crushed stone shall be placed in the trench for its full width to uniformly support the pipe at the required line and grade. Suitable recesses shall be provided in the cradle to permit adequate clearance for bells, couplings or similar projections.

2. Cradle material shall be spread in 4-inch layers, and each layer shall be completed with tampers until the bedding has reached the spring line of the pipe.

3. The balance of the bedding to 1-foot above the pipe shall be as specified for ordinary bedding above.

C. Crushed Stone Encasement

1. Crushed stone encasement used for PVC and HDPE pipe and where specified or required in the field, the pipe shall be supported in crushed stone encasement. The crushed stone shall be placed in the trench for its full width to uniformly support the pipe at the required line and grade.

2. Encasement material shall be spread in 4-inch layers and each layer shall be compacted with tampers until the required total depth of bedding has been built-up as specified herein.

D. Concrete Encasement

1. Where specified or required in the field, the pipe shall be supported by Concrete Encasement.

2. The trench shall be excavated to the required depth. The excavated space shall then be completely filled with, and the entire pipe encased in concrete such that the concrete measures a minimum 1-foot above the top of the pipe. The total minimum width of the Concrete Encasement shall equal the width of trench excavation. Unless otherwise shown on the Drawings or specified herein, concrete shall be in accordance with the requirements of Section 03300, CAST-IN-PLACE CONCRETE. Freshly poured concrete shall be maintained free from ground water for at least the first four (4) hours. No backfilling of the trench shall begin until a minimum time period of 24 hours has elapsed after the encasement has been poured.

E. Concrete Cradle

1. Where unstable conditions are encountered, the pipe shall be supported on Concrete Cradle. Concrete Cradles shall be installed where no suitable supporting soil or rock stratum exists within two feet of the bottom of the pipe.

2. The concrete cradle shall be furnished and installed equal to the "Concrete Encasement," except that only that portion of the encasement at the below horizontal diameter of the pipe shall be poured, forming a true cradle under the bottom half of the pipe.

3. The balance of the bedding to 1-foot above the pipe shall be as specified for ordinary bedding above.

3.11 FOUNDATION

A. Crushed Stone - For Foundation

1. In all bedding conditions where a suitable supporting soil or rock stratum occurs at a depth greater than required on the Drawings but less than 2 feet below the pipe, where modernly unstable soil conditions are encountered, where the trench is excavated below the specified depth or where required by the Engineer, the foundation shall be modified as follows:

   a. Except in the case of over-excavation where no extra excavation will be required, the trench shall be excavated to the depth necessary to reach the suitable supporting stratum. Crushed stone shall be spread in 4-inch layers, and each layer shall be compacted with 20 pound hand or pneumatic tampers.

b. The foundation shall carry vertically from the supporting stratum up to the required level depending on the pipe diameter and the type of bedding specified.

2. When the above method of stabilizing trenches with crushed stone is unfeasible, the Contractor shall proceed when requested by the Engineer as described in Paragraph 3.7, QUICKSAND EXCAVATION.

3.12 BACKFILLING

A. General

1. No backfilling shall be done before the Engineer gives permission. After pipes have been checked for alignment and bedding, the backfilling may be started. Backfill material may be deposited in trench either by hand or machine. Sufficient number of men shall be available to spread the backfill in uniform layers.

2. At least 30 inches of cover over the top of the pipe shall be provided before the trench is wheel-loaded.

B. Backfilling In Non-Traffic Areas (Grass, Earth Plots or Sidewalks) (Not Applicable to VDOT Rights of Way)

1. Initial Backfilling of Pipe

a. This portion of the pipe trench shall be backfilled with crushed stone to provide crushed stone bedding, installed as described under Paragraph 3.10 of this Section.

b. When concrete cradle is used the initial backfill will start at the top of the concrete and then continue as specified above.

c. When concrete encasement is used, the initial backfill of crushed stone will not be required.

2. Backfilling

a. Backfill within public road rights-of-way according to Virginia Department of Transportation Road and Bridge Specifications, where those requirements may be more stringent than the procedures outlined below.

b. Backfill as promptly as is consistent with non-damage to the structures, but do not backfill before the Inspector gives permission.

c. Place and compact bedding as directed in Paragraph 3.10 of this section for the type employed.

d. Use excavated material conforming to Par. 2.2. If sufficient excavated material is not available, secure and place imported material of comparable quality to complete the backfill.

e. In all cases of backfilling, tamp earth backfill carefully over the pipe up to a point 12 inches above its crown. Hand place and compact backfill material in loose four (4) inch layers, The remainder of the trench may be backfilled by machinery in loose eight (8) inch layers. Thoroughly compact each layer for the full trench width using mechanical tampers capable of achieving compacted density specified in Par. 3.13, below.

f. Do not backfill in freezing weather except by permission of the Engineer and do not use any frozen material. Make no fill where the material already in the trench is frozen.

g. If settlement occurs, deposit additional backfill and mechanically compact to required elevation.

h. After sufficient compaction and settlement has been obtained, complete the grading of the trench by smoothing off the trench surface and making it conform to the surface of the adjacent ground.

3. Settlement

a. If settlement occurs, additional backfill shall be deposited and mechanically compacted to the required elevation.

3.13 COMPACTION AND TESTING

A. In all areas, thoroughly compact the backfill over the pipe by use of vibratory tamping pads or, where these cannot be used, by mechanical or hand tamping. Compact backfill to within the following percentage ranges of maximum density at optimum moisture content:

1. Unpaved Areas: Not less then ninety percent (90%).

2. Paved Areas: Not less than ninety-five percent (95%).

3. State Highway: VDOT requirements if more stringent than the above.

B. Determine the optimum moisture content and the maximum density of each type of material used for backfill by "Tests for Moisture-Density Relations of Soils, Using 10 lb. Rammer and 18-inch Drop," (ASTM D1557) or (AASHTO T-180), or by Nuclear Methods (ASTM D3017).

C. Determine the field moisture content of materials being compacted by "Laboratory Determination of Moisture Content of Soil," (ASTM D2216). Determine the field density of compacted material by "Density of Soil in Place by Sand Cone Method," (ASTM D1556) or by Nuclear Density testing equipment (ASTM D2922).

D. Performed sufficient field density and field moisture content tests on each lift of material at locations specified by the Engineer or his representative, to assure the Engineer that the requirements of this Section of the Specifications are complied with. Perform a minimum of one test for each 500 feet of pipeline per each one (1) foot lift of backfill.

E. Submit reports verifying these test result to the Engineer. The Engineer may order additional compaction and testing if the above tests prove inadequate compaction is being obtained; complete additional compaction and testing at the Contractor's sole expense until compaction meets minimum standards.

F. Obtain and pay for the services of a qualified independent testing laboratory acceptable to the Engineer, to perform the above tests.

3.14 MAINTENANCE OF BACKFILLED EXCAVATIONS.

A. Maintain backfilled and repaved areas in proper conditions until the end of the guarantee period for the project.

1. Promptly correct all defects. If the Contractor fails to do so within a reasonable time after the receipt of written notice form the Owner, the Owner may remedy such defects and deduct the cost thereof from any monies due or to become due the Contractor under the contract. In an emergency, the Owner may correct any dangerous condition without giving previous notice to the Contractor and retain the cost of so doing from any monies due the Contractor.

2. The Contractor is responsible for any injury or damage that may result from improper maintenance of trenches or pavement any time before the end of the guarantee period.

3.15 DISPOSAL OF MATERIALS

A. Remove rock, macadam and other rock like street surfacing materials that are too large for use in backfill from the work sites as the work progresses. Remove surplus materials of all types when performing final surface restoration. Do not deposit any material removed from the site on private property will written consent of the owner has been copies to the Engineer.

END OF SECTION